Chapter 5. Wetlands

Section A. The Ecosystem: What are Wetlands?

Wetlands are transitional areas between upland and deepwater aquatic systems. Wetlands come in all shapes and sizes and go by names such as marshes, swamps, scrub-shrubs, bottomlands, oxbows, or sloughs (Fig. 36). The regulatory definition of wetlands is "land that has a predominance of hydric soils, and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions" [40 CFR 230.3 (t)].

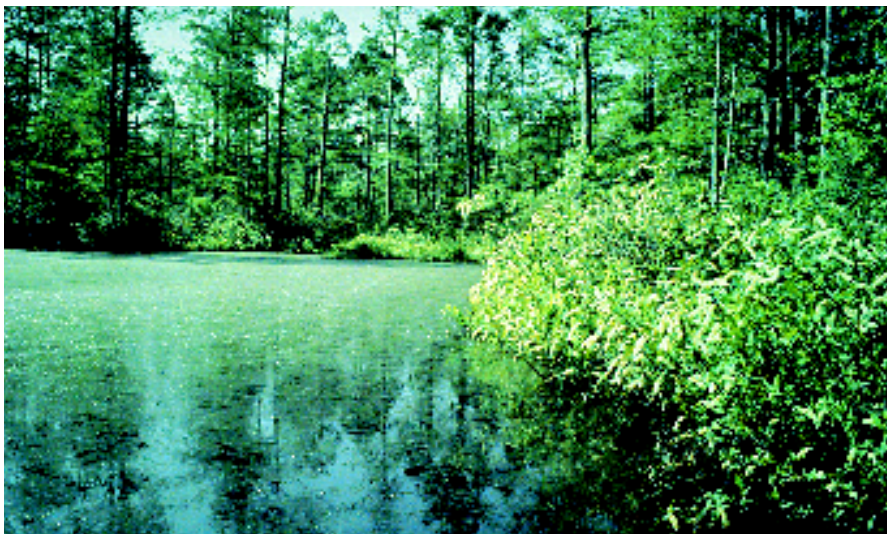

Figure 36: Murphy's Pond, Hickman County

All wetlands have three things in common:

- a soil that is at least periodically saturated or ponded and exhibits anaerobic conditions (offering no air or free oxygen);
- vegetation that can tolerate anaerobic conditions;
- water to create ponding or saturated conditions of the soil in the upper layer during the growing season.

The water table of wetlands can be at or near the soil surface, or it can inundate the land with shallow water. Water controls the types of plant and animal communities living in wetlands. Most plants cannot survive in waterlogged soils found in wetlands, while others need soils that remain wet over a long period of time. The presence of certain water-loving plants is used as one indicator to identify wetlands. Two other indicators must be present to identify wetlands: hydric soil and hydrology. The U.S. Army Corps of Engineers is responsible for jurisdictional wetland determinations in Kentucky.

For a long time, wetlands were regarded as wastelands. They were excavated, converted, filled, developed, drained, or used as places to dump household or hazardous waste. Over time, these actions and attitudes resulted in losses of more than half (56 percent) of the wetlands in the lower 48 states. Kentucky alone has lost more than 80 percent of freshwater wetlands. Losses have caused increases in downstream flood events and water quality problems. There has also been a dramatic decrease in migratory waterfowl populations.

By 1970, scientists began to realize the importance of wetlands and to identify the many functions associated with wetland ecosystems. They provide us with cleaner water, flood protection, sources of food, recreational opportunities, and lots of beautiful wildlife to enjoy (Fig. 37 through 49). They help keep the environment in balance, sustaining a healthier watershed.

Wetlands act as a type of filter, removing materials from storm water runoff before the runoff reaches streams. Wetlands remove pollutants, including sediment, from the water column. They substantially improve water quality by sediment

Figure 50: Cypress trees in early fall; Fish Pond, Fulton County

trapping, nutrient removal, and chemical detoxification.

Wetlands can store floodwaters, particularly frequently flooded bottomland hardwood areas along rivers. How much a particular wetland site can reduce flood levels depends upon the size, shape, and location of the wetland in the watershed. During high runoff, wetland soils temporarily store some of the floodwaters. After the flood event, the water is slowly released (Fig. 50).

Vegetated wetlands along shorelines of lakes, rivers, and streams help protect against streambank erosion. The energy released by wave action or water velocity is partially absorbed by the vegetation. The vegetation further helps bind the sediment and soil particles in dense root systems.

Wetlands provide essential habitat for numerous wildlife species. The dense vegetation adapted to wetlands serves as a food source for wildlife. The vegetation also provides cover, protection, habitat, and travel corridors for wildlife. In Kentucky, about 55 percent of the species listed by federal and state government as threatened, endangered, or of special concern depend heavily on wetland aquatic ecosystems (Fig. 51).

Anyone who would like specific wetland information concerning education, wetland functions, non-regulatory, regulatory, or options for wetland protection can contact the Environmental Protection Agency's (EPA) Wetland Hotline at 1-800-832-7828. This is a toll-free telephone service that also acts as a point of contact for the Wetlands Division within EPA's Office of Wetlands, Oceans and Watersheds. They provide a wide range of information on wetland protection efforts involving EPA and other organizations.

Figure 51: Observing wetland wildlife

Section B. The Interagency-Approved Kentucky Guidelines on Wetland Mitigation

Section 404 of the Clean Water Act requires that applicants who propose projects that will result in the loss of jurisdictional wetlands must demonstrate that the project 1) avoids impact to wetlands where practical, 2) minimizes the impacts to those wetlands that cannot be avoided, and 3) mitigates for the loss of any jurisdictional wetlands. This chapter presents guidelines on how to design a complete mitigation package so as to avoid delays in the permitting process.

The "Wetland Compensatory Mitigation and Monitoring Plan Guidelines for Kentucky (Kentucky Guidelines)" was jointly prepared in 1993 by representatives from the Louisville District Corps of Engineers, Region 4 U.S. Fish and Wildlife Service, Region 4 U.S. Environmental Protection Agency, the Kentucky Division of Water, and the Kentucky Department of Fish and

Wildlife Resources. It was revised in 1996 in a cooperative effort with resource agencies, consultants, and representatives from regulated industries. These Kentucky Guidelines are designed to assist applicants in the preparation and development of compensatory mitigation and monitoring plans associated with projects requiring Department of the Army (Corps) permits and Kentucky water quality certification.

The mitigation guidelines are intended to be just that, a set of guidelines. The guidelines are not regulatory requirements. However, many of the delays in the permitting process can be attributed to deficiencies in the applicant's proposed mitigation plan. Many or all of these deficiencies can be avoided by referring to the mitigation guidelines. Not all of the items listed in the guidelines will be applicable to every mitigation scenario. The applicant will need to choose those items that are applicable to the specific set of circumstances regarding both the impacted wetlands and the proposed mitigation site. In making these choices, the applicant should remember that the goal in wetland mitigation is the **replacement of those wetland *functions* that the pending project proposes to negate.**

These guidelines will serve to provide consistency in the permit application evaluation process for wetland-related impacts. For more information on the Guidelines, please refer to the U.S. Army Corps of Engineers, Louisville District, or visit the Kentucky Division of Water, Water Quality Certification World Wide Web site at this address: http://water.nr.state.ky.us/dow/dwwqc.htm. The Louisville District Corps should be contacted for any suggested changes to the Kentucky Guidelines.

Appendix 1 refers to maps, plans, and drawings needed for a wetland mitigation plan. Appendix 2 is the wetlands functions checklist needed for site description and monitoring. Appendix 3 is a list of wetland plants that may be used to revegetate a mitigated wetland. These appendices are directly from the interagency Kentucky Wetland Guidelines.

Part 1. Development Site Description

I. Introduction
   - A. Brief summary of overall proposed project and purpose
   - B. Impacted wetland acreage
     1. Primary
     2. Secondary

II. Location
   - A. Narrative description
     1. Local (i.e., directions to the site using road names, highway numbers and mileage distances)
     2. Relative geographic location within watershed (e.g., headwater, stream order, floodplain, isolated, etc.)
     3. Surrounding land use
        - a. Percentage of land-use types(s) occurring within at least a 1,000 ft band around the wetland area.
        - b. Significant land use(s) within watershed which would affect the hydrological inputs or be affected by the hydrological outflows from the wetland

     4. Proximity to existing wetlands
        - a National Wetlands Inventory Map
        - b. Field observations

   - B. Maps (8 1/2" x 11")
     1. County road map with proposed development site clearly outlined
     2. USGS quadrangle map with proposed development site clearly outlined
     3. Existing conditions (see Appendix 1)
     4. National Wetlands Inventory Map
     5. Aerial photography, if available

III. Identification of responsible parties (names[s],titles[s], address[es], and phone number[s])

A. Applicant(s)
B. Contact person(s) if applicant is a company
C. Consultant or preparers of compensatory mitigation plan (include resume with references)

IV. Site characterization
A. Wetland classification (Cowardin et al, 1979) (Brinson 1993)
B. Wetland functions and values (Narrative based on checklist in Appendix 2) (Include copies of completed checklist[s])
1. Hydrology (surface and groundwater)
2. Biogeochemical processes
3. Plant maintenance (see Appendix 2)
4. Habitat maintenance (see Appendix 2)
C. Soils
1. Soils series and description
2. Field characteristics (soil color, texture, composition, percent of organic material and other hydric soil indicators)
D. Vegetation (Refer to wetland delineation)
1. Species composition and indicator status by stratum (overstory, understory, herbaceous) (list by scientific and common names)
2. Community structure
a. Dominant species for each stratum
b. Zonation (if present)
E. Hydrology (utilizing best available data)
1. Surface Water
a. Hydroperiod
i. Gage data
ii. Documented observation
iii. SCS county soil survey
iv. Wetland delineation hydrologic data/indicators
v. Flow conditions (hydrodynamics)
b. Source
i. Overbank flooding
ii. Precipitation
iii. Groundwater seeps
iv. Location and types of inflows and outflows
2. Seasonal groundwater table elevations/fluctuations
a. SCS county soil survey
b. Other published data (e.g. Ky. Division of Water)
c. Wetland delineation hydrology data/indicators

Part 2. Proposed Compensatory Mitigation Site Description

I. Location
A. Narrative description
1. Local (i.e., directions to the site using road names, highway numbers, and mileage distances)
2. Relative geographic location within watershed (e.g., headwater, stream order, floodplain, isolated, etc.)
3. Surrounding land use(s)
a. Percentage of land-use type(s) occurring within at least a 1,000-foot band around the wetland area
b. Significant land use(s) within watershed that would affect the hydrological inputs or be affected by the hydrological outflows from the wetland
4. Proximity to existing wetlands
a. National Wetlands Inventory Map
b. Field observations
B. Maps (8 1/2 " x 11 ")
1. County road map with proposed compensatory mitigation site clearly outlined
2. USGS quadrangle map with

proposed compensatory mitigation site clearly outlined
3. National Wetlands Inventory
4. Existing conditions (see Appendix 1)
5. Proposed conditions (see Appendix 1)
6. Aerial photography, if available

II. Proposed wetland classification (if out-of-kind, present rationale)
   A. Cowardin classification (Cowardin et al; 1979)
   B. Hydrogeomorphic classification (Brinson 1993)
   C. Natural Resources Conservation Service (NRCS) Mapping Conventions (if applicable)

III. Functions and values (narrative based on checklist in Appendix 2)
   A. Existing
      1. Hydrology
      2. Biogeochemical processes
      3. Plant maintenance
      4. Habitat maintenance
      5. Watershed map (see Appendix 1)
   B. Proposed
      1. Hydrology
      2. Biogeochemical processes
      3. Plant maintenance
      4. Habitat maintenance
      5. Watershed map (See Appendix 1)

IV. Soils
   A. Soils series and description
   B. Analytical data such as saturated hydraulic conductivity and redox potential
   C. Soil analyses
      1. Nutrients
      2. Texture
      3. Organic matter content

V. Proposed vegetation
   A. Species composition and indicator status (list by scientific and common names) (See Appendix 3 for recommended species)
      1. Overstory composition (minimum of 4 species recommended)
      2. Understory composition (minimum of 3 species recommended)*
      3. Herbaceous composition (minimum of 5 species recommended)*
      4. Species predicted to invade naturally

*Understory and herbaceous species may not need to be planted if a good seed source is available.

   B. Community structure
      1. Dominant species for each stratum
      2. Zonation (if applicable)
   C. Planting
      1. Rates (e.g. 1,000/acre for direct seeding)
         a. Wildlife objectives - 194/acre accomplished by 15 X 15 foot spacing
         b. Timber production - 437/acre accomplished by 10 X 10 foot spacing
      2. No single species comprising significantly more than 25% of total
      3. Concentrate on heavy masted species (e.g. oak and hickory) - light masted species (e.g. maple and ash) are expected to invade most sites naturally.
      4. Stock description and origin (e.g. acorn, bare root stock, balled & burlap, container grown)

VI. Hydrology
   A. Existing
      1. Surface water
         a. Hydroperiod
         b. Source
            i. Overbank flooding
            ii. Precipitation
            iii. Groundwater seeps
         c. Hydrodynamics

2. Groundwater
    a. Seasonal table elevations
        i. Soil survey
        ii. Well data (if available)
    b. Low-flow level in adjacent stream (if applicable)

B. Proposed
1. Surface water
    a. Hydroperiod
    b. Source
        i. Overbank flooding
        ii. Precipitation
        iii. Groundwater seeps
    c. Hydrodynamics
2. Groundwater
    a. Seasonal table elevations
    b. Low-flow level in adjacent stream channel (if applicable)

Part 3. Success Criteria and Performance Standards

I. Construction schedule: Construction should be completed prior to or concurrently with project completion.

II. Soils parameters (if necessary) will be used to provide supportive evidence of success but will not carry minimum requirements.
A. Soils redox exhibits anaerobic conditions for 5 to 12 1/2% of the growing season (or as defined in the current wetland delineation manual). Provide statistical proof that sample data falls within success criteria.
B. Organic matter should exhibit an increase over time

III. Vegetation
A. Mean density per acre meets that proposed based on compensatory mitigation objectives and composed of at least 50% approved planted species, which have been established on-site for five consecutive successful years.
B. No single species constitutes significantly more than 25% of he surviving species.
C. Meets current federal delineation manual for hydrophytic vegetation.
D. Meets proposed Cowardin classification (see Chapter 3.I.C.4)

IV. Hydrology - hydroperiod is restored as defined in Section B, VI.B.; at a minimum the site is inundated and/or saturated for 5 to 12 1/2% of the growing season (or as defined in the current wetland delineation manual). Provide statistical proof that sample data falls within success criteria.

V. Water quality
A. Meets Kentucky Water Quality Standards
B. Will be site specific and based on compensatory mitigation objectives.

VI. Functions and values of the compensatory mitigation site are comparable to those identified from the development site (see checklist - Appendix 2).
A. Hydrology
B. Biogeochemical processes
C. Plant maintenance
D. Habitat maintenance

Part 4. Monitoring

I. Parameters
A. Construction schedule
1. Duration of compensatory mitigation
2. Plan showing each phase of the compensatory mitigation and the proposed dates of initiation and completion; e.g., earth moving, hydrology restoration, revegetation, and monitoring phases. (Deviations from projected dates will need to be pre-approved by the regulatory agencies.)

B. Soils*
1. Redox potential
2. Organic matter content
3. Nutrients

C. Vegetation*
1. Species composition and indica-

tor status (list by scientific and common names)
2. Survival rate of planted species
3. Ratio of planted species vs. volunteer species
4. Individual species importance values

D. Hydrology*
1. Surface water hydroperiod
a. Source
i. Precipitation
ii. Overbank flooding
b. Depth(s)
c. Frequency
d. Duration of inundation
2. Seasonal groundwater table elevations

E. Water quality* (site specific and based on compensatory mitigation objectives)

F. Functions and values (narrative based on checklist in Appendix 2)
1. Hydrology
2. Biogeochemical processes
3. Plant maintenance
4. Habitat maintenance

II. Sampling frequency

A. If necessary, sample soils redox potential at frequency sufficient to demonstrate the site exhibits anaerobic conditions for 5 to 12 1/2% of the growing season (or as defined in the current wetland delineation manual).

B. Sample vegetation (woody layer and herbaceous layer) once in late summer or early fall until there have been two consecutive successful years (see Chapter 4 for Success Criteria); afterwards, sample once in early fall for the remainder of the monitoring period.

C. Hydrology
1. Record surface water during each inundation event during the growing season (e.g., USGS data/cork staff gage).
2. Record groundwater every 9 days from March 15 through June 30 and monthly the remainder of the growing season.

D. Water quality sampling frequency will be determined on a site-specific basis.

E. Complete the function and values checklist (Appendix 2) annually in the spring.

III. Monitoring reports

A. Report format should follow guidelines format.

B. Should include interpretation of data as performed by a qualified individual.

C. Results and discussions should address each item included within these guidelines.

D. Submit reports biannually until there have been two consecutive years of successfully meeting performance criteria; submit annually thereafter.

E. Photographic documentation should be included of wetland and surrounding landscape(s) from all four cardinal directions using 35 mm color film from permanent photo stations (these photo stations need to be depicted on plan view sheets to promote consistency from one monitoring session to the next).

F. List names, addresses, and phone numbers of persons/entities responsible for each type of sampling and report preparation.

— Follow standard sampling methods and provide specific citation for each. If alternative methods are selected, describe and reference for approval by the regulatory agencies. Characterize the compensatory mitigation site by using an adequate number of sample sites and locations. Ensure validity of sampling results through standard statistical methods.

Part 5. Contingency Plan

I. Reporting Protocol - If a success criterion is not met for all or any portion of the compensatory mitigation project in any

year, and/or if the final success criteria are not satisfied, the permittee shall prepare an analysis of the cause(s) of failure and, if determined necessary by the regulatory agencies, propose remedial action for pre-approval.

II. Alternative locations for contingency compensatory mitigation - indicate specific alternative compensatory mitigation locations that may be used in the event that compensatory mitigation cannot be successfully achieved at the intended site.

Part 6. Permanent Protection Measures

I. To insure permanent protection, transfer of ownership of the compensatory mitigation site to nonprofit environmental organization or resource management agency is recommended.

II. Provide proposal for protection of all compensatory mitigation lands, in perpetuity, as functional wetlands in accordance with the compensatory mitigation plan.

III. Provide cop(ies) of all written agreements with land owner clearly describing compensatory mitigation site and restrictions.

IV. Provide copy of official deed showing compensatory mitigation site and restrictions binding on current and all future owners.

V. Provide copy of long-term management plan ensuring the maintenance of compensatory mitigation site in accordance with compensatory mitigation objectives.

Appendix 1: Maps, Plans, and Drawings for Wetlands

I. Existing conditions (or in case of violation site - preexisting conditions as available) of development site and proposed compensatory mitigation site
   A. Plan view sheets (Scale: 1 inch = 400 feet)
      1. Soil types
      2. Hydrological conditions including 1-foot contours
      3. Vegetative distribution patterns
      4. Location and contours of drainage ditches, levees, berms, and spoil piles
      5. Surrounding land use(s)
   B. Cross sectional profiles
      1. Width, depth, and bottom elevation of ditches
      2. Height and width of berms, levees, and spoil areas

II. Proposed restored compensatory mitigation site conditions
   A. Plan view sheets (Scale: 1 inch = 400 feet)
      1. Monitoring stations; e.g., groundwater wells, staff gauges, etc.
      2. Soil types and depth used for areas without adequate hydric soils initially (primarily for creation)
      3. Proposed vegetation planting composition, planting rates, and species distribution patterns
      4. Hydrology restoration measures, including 1-foot contours, elevations, ditch checks, berms, levee breeches, etc.
      5. Sediment and erosion control; e.g., location of check dams, straw bales, etc.
      6. Earth moving and, if applicable, disposal area used for excess material.
      7. Surrounding land use(s)
   B. Cross sectional profiles
      1. Width, depth, and bottom elevation of ditches
      2. Height and width of berms, levees, and spoil areas

III. As-Built Plans - should be signed by a certified professional engineer and submitted to the Army Corps of Engineers within 60 days after compensatory mitigation project completion.

Appendix 2: Wetland Functions Checklist

This checklist was designed by the interagency reviewers of the Wetland Mitigation Guidelines for Kentucky. The list provided here is only a brief summary about hydrogeomorphic (HGM) processes of wetlands. The foundation of HGM assessment is reference wetland comparisons, which requires the completion of regional guidebooks. The Western Kentucky Regional Guidebook can be obtained from the Environmental Protection Agency when completed.

The assessment of function for mitigation sites should be based upon the Hydrogeomorphic Classification System for Wetlands (Brinson 1993). This classification is based upon three basic properties which provide insight into wetland function. These three basic properties are: geomorphic setting (riverine, depressional, fringe); water source (precipitation, lateral flows from upstream or upslope, and ground water); and hydrodynamics (vertical, unidirectional and horizontal, and bidirectional and horizontal). To determine the relative potential for a mitigated wetland to achieve similar hydrogeomorphic functions as a project site, selected reference wetland (or selected reference population), and therefore achieve success, the sites must be compared hydrogeomorphically. The mitigation site must be of a similar hydrogeomorphic class (i.e., have a similar hydrogeomorphic setting, water source, and hydrodynamics) to the project site to approach a successful mitigation project from a functional standpoint. It is important to note that "success" in this context refers to ecological replacement of functions lost due to development of a particular wetland site.

The following represents categories of function attributed to riverine and depressional wetlands. As further work on wetland systems is completed and new information is available, certain categories of function may be deleted or added.

Riverine wetland functions:

Hydrology -

Dynamic surface water storage [DSWS] - Capability of a wetland to detain moving water from overbank flow for a short duration when flow is out of the channel; associated with moving water from overbank flow and/or upland surface water inputs by overland flow or tributaries.

Long-term surface water storage [LTS] - Capability of wetland to store (detain) surface water for long durations; associated with standing water not moving over the surface. Sources of water may be overbank flow, channel flow, and/or subsurface flow. Storage is associated with standing water.

Energy dissipation [ED] - Allocation of the energy of water to other forms as it moves through, into, or out of the wetland as a result of roughness associated with large woody debris, vegetation structure, micro- and macrotopography, and other obstructions.

Subsurface water storage [SWS] - Availability of water storage beneath the wetland surface. Storage capacity becomes available as periodic drawdown of water table or reduction in soil saturation occurs.

Moderation of groundwater flow or discharge [MGWF] - Capacity of a wetland to moderate (slow) the rate of groundwater flow or discharge from upgradient (i.e., upstream) or upslope (i.e., lateral) sources.

Biogeochemical Processes -

Nutrient cycling [NC] - Abiotic and biotic processes that convert elements from one form to another; primarily recycling processes.

Removal of imported elements and compounds [REC] - The removal of imported nutrients, contaminants, and other elements and compounds.

Retention of particulates [RP] - Deposition and retention of inorganic and organic particulates from the water column (>0.45 um including coarse woody debris) primarily through physical processes.

Organic carbon export [OCE] - Export of dissolved and particulate organic carbon from the wetland. Mechanisms include leaching, flushing, displacement, and erosion.

Plant Maintenance -

Maintain characteristic plant community [MCPC] - Species composition and physical characteristics of living plant biomass. The emphasis is on the dynamics and structure of the plant community as revealed by the dominant species of trees, shrubs, seedlings, saplings, and ground cover, and by the physical characteristics of vegetation.

Maintain characteristic detrital biomass [DB] - The processes of production, accumulation, and dispersal of dead plant biomass. Sources of organic matter may be onsite, upslope/ upgradient areas, or backwater.

Habitat Maintenance -

Maintain spatial structure of habitat [MSSH] - The capacity of a wetland to support animal populations and guilds by providing heterogenous habitats.

Maintain habitat interspersion and connectivity [MIC] - The capacity of a wetland to permit aquatic organisms to enter and leave the wetland via permanent or ephemeral surface channels, overbank flow, or unconfined hyporheic gravel aquifers. The capacity of the wetland to permit access of terrestrial or aerial organisms to contiguous areas of food and cover.

Maintain distribution and abundance of invertebrates [MDAI] - The capacity of a wetland to maintain characteristic density and spatial distribution of invertebrates (aquatic, semi-aquatic, and terrestrial).

Maintain distribution and abundance of vertebrates [MDAV] - The capacity of a wetland to maintain the density and spatial distribution of vertebrates (aquatic, semi-aquatic, and terrestrial) that utilize wetlands for food, cover, rest, and reproduction.

Depressional wetland functions:

Hydrology -

Surface water storage [DPSWS] - Capability of wetland to store or detain precipitation. The predominant water source is precipitation; however, some overland flow may originate from adjacent areas of higher elevation.

Subsurface storage of water [DPSSW] - Capacity to store water below the wetland surface.

Biogeochemical -

Nutrient transformations and processing [NTP] - Abiotic and biotic processes that convert elements from one form to another; primarily recycling processes. Growth or biomass accumulation and decomposition ensures that elements are converted between organic and inorganic forms.

Removal of elements and compounds in precipitation and dryfall [REC] - The removal of nutrients, compounds, and dryfall imported directly by precipitation or by overland flow from adjacent areas. This differs from the NUTRIENT TRANSFORMATIONS AND PROCESSING function where the emphasis is on interconversions and recycling on less than an annual time scale. Retention of elements and compounds is the removal from cycling on a more or less permanent basis by one or several of the following:

1) Loss to the atmosphere - occurs as nitrate is denitrified to N2 or N2O, ammonia is volatilized, and sulfur is converted to gaseous form;
2) Deposition and burial in sediments - occurs through burial, precipitation (removal of phosphorous by iron III, sorption (heavy metals with organic matter), and others.
3) Assimilation into biomass by storage in perennial plant parts of herbaceous species and storage in long-lasting woody biomass.

Organic carbon export [DPOCE] - Export of dissolved and particulate organic carbon from the wetland through leaching, flushing, displacement, and erosion.

Depressional wetlands also function to maintain characteristic plant communities, detrital biomass, vertical habitat structure, and food web support for animals. These functions are the same as those characterized for riverine wetlands and utilize the same indicators.

Brinson (1993) also discusses indicators of function as derivatives of the three basic properties of wetlands (geomorphic setting, water source, and hydrodynamics). These indicators entail short-term (e.g., high water marks, herbaceous plant cover, debris wracks) and long-term (e.g., geomorphic structure, forest canopy species composition) indicators of wetland function and processing. The following list represents those indicators of function which can be detected on mitigation sites within a short time frame and can be used as indicators of functional replacement.

Checklists should be completed annually and submitted to the Corps for analysis. However, many of these indicators are temporal in nature (i.e., occur only in spring season when water is on the sites), and notes should be taken during other monitoring visits to document the presence of any of these indicators. Direct observation of any function (e.g., observation of ponded water during the growing season, groundwater within 12 inches of the surface) should be documented whenever possible. Indicators on the checklist are marked only as being present or absent. However, observations quantifying any indicator (i.e., depth of water on the site, percent of site covered by water, depth to saturation, percent cover, zonation of surface or groundwater patterns, etc.) should be included whenever possible. This information will assist the Corps and other resource agencies in assessing the ecological development of the mitigation site.

Finally, this constitutes a preliminary list of indicators of function. Once the mitigation and monitoring commences additional signs of ecological function may be observed that are not on this list. These observations should be documented and their ecological significance discussed. It is anticipated that such observations may add a great deal of pertinent information to the resource agencies in assessing the mitigation site's success.

Indicators of function

—— Microtopographic relief (e.g. hummocks, scour around trees, small surface channels) [Microtopographic relief occurs on the order of a few meters or less, such as pit-and-mound features from windthrow, hummocks, buttressing of trees, large logs, etc.]

—— Overbank flooding (direct observation or indirect evidence such as water, aerial photographs, or gage data)

—— Sediment scour and deposition

—— Redistribution of detritus (e.g., wrack, debris jams, drift lines)

—— Localized sediment deposition

—— Structural roughness (e.g., vegetation, microtopographic relief)

—— Presence of debris jams and wrack

—— Intermediate soil porosity:

Sediments must be capable of developing unsaturated pore space in order to have the capacity to store water. (Fine-grained soils with low transmissivity function poorly in subsurface storage of water because of their resistance to infiltration and because they maintain thick capillary fringes that don't develop adequate unsaturated volume for subsurface storage).

—— Reduced soil conditions (e.g., mottling, gleying, organic matter accumulation, redox potential, etc.) Contributes to the maintenance of hydric soils, anaerobic biogeochemistry, and plant and animal species composition adapted to life in reduced conditions.

—— Saturated soils unrelated to overbank flooding (i.e., maintained in spite of the lack of precipitation and overbank flooding). Groundwater discharge originating upslope may maintain saturation when other supplies cease.

—— Seeps at upland/wetland interface or at surface of wetland (such seeps are indicative of water moving vertically upward)

—— Floodplain ponding (direct observation or indirect evidence)

—— Sparse herbaceous growth in depressions

—— Low permeability soils

—— Vegetation indicative of standing water (for example, submerged aquatic and/or obligate emergents)

—— Vegetative community (density, basal area, vertical stratification, cover, and species composition) typical of reference site with evidence of nutrient uptake and release (plant growth, litter production, decomposition rate, etc.)

—— Surface films or layers of recently deposited sediments

—— Debris blockages in active channels, blockages in side channels, accumulations in microtopographic depressions, accumulations in vegetation, redistribution off-site

INDICATOR CHECKLIST

INDICATOR	PRESENT	ABSENT
Microtopographic relief	_____	_____
Overbank flooding	_____	_____
Sediment scour and deposition	_____	_____
Redistribution of detritus	_____	_____
Localized sediment deposition	_____	_____
Structural roughness	_____	_____
Presence of debris dams and wrack	_____	_____
Intermediate soil porosity	_____	_____
Reduced soil conditions	_____	_____
Low permeability soils	_____	_____
Saturated soils unrelated to overbank flow	_____	_____
Seeps at upland/wetland interface or at wetland surface	_____	_____
Floodplain ponding	_____	_____
Sparse herbaceous growth in depressions	_____	_____
Submerged aquatic vegetation	_____	_____
Obligate wetland vegetation dominates	_____	_____
Vegetative community typical of “reference” (impact) site	_____	_____
Surface films or layers of recently deposited sediments	_____	_____
Debris dams in active channels	_____	_____
Debris dams in side channels	_____	_____
Debris accumulations in microtopographic depressions	_____	_____
Debris accumulations in vegetation	_____	_____
Debris redistribution off-site	_____	_____

Appendix 3: Wetland Plant List

The compensatory mitigation site should be revegetated based upon vegetation surveys of reference wetlands in the area and known information about species tolerance to various wetland conditions. The following list contains common species occurring in three different water regimes, as classified by the National Wetland Inventory, of Kentucky's forested wetlands. It should be used as a guide to recommended species composition. Please note that the light masted species such as red maple, green ash, sycamore, river birch, and cottonwood designated by an "I" are expected to invade most sites naturally and do not need to be planted. (Species designated by an asterisk, "*", are preferred dominants.)

Common Name	Scientific Name
PFO1A WETLANDS (Temporarily Flooded)	
Overstory	
Pin oak*	*Quercus palustris*
Shellbark hickory*	*Carya laciniosa*
Swamp chestnut oak	*Quercus michauxii*
Cherrybark oak	*Quercus pagoda*
Bur oak	*Quercus macrocarpa*
Green ash (I)	*Fraxinus pennsylvanica*
Red maple (I)	*Acer rubrum*
Sweetgum (I)	*Liquidambar styraciflua*
Sycamore (I)	*Platanus occidentalis*
Sugarberry	*Celtis laevigata*
Black gum	*Nyssa sylvatica*
Understory	
Arrow-wood	*Viburnum dentatum*
Deciduous holly	*Ilex decidua*
Gray dogwood	*Cornus racemosa*
Silky dogwood	*Cornus amomum*
American hornbeam	*Carpinus caroliniana*
Persimmon	*Diospyros virginiana*
Elderberry	*Sambucus canadensis*
Herbaceous	
Jewelweed	*Impatiens spp.*
Sedges	*Carex spp.*
Spikerushes	*Elocharis spp.*
Flatsedges	*Cyperus spp.*
Nutsedge	*Cyperus strigosus*
Chufa	*Cyperus esculentus*
Clearweed	*Pilea pumila*

PFO1C WETLANDS (Seasonally Flooded)

Overstory

Pin oak*	*Quercus palustris*
Shellbark hickory*	*Carya laciniosa*
Overcup oak	*Quercus lyrata*
Swamp white oak	*Quercus bicolor*
American elm (I)	*Ulmus americana*
Swamp cottonwood	*Populus heterophylla*
Black gum	*Nyssa sylvatica*

Understory

Withe-rod	*Viburnum cassinoides*
Silky dogwood	*Cornus amomum*
Sugarberry	*Celtis laevigata*
Persimmon	*Diospyros virginiana*
Spicebush	*Lindera benzoin*
Steeplebush	*Spiraea tomentosa*
Deciduous holly	*Ilex decidua*

Herbaceous

Beggarticks	*Bidens spp.*
Bulrushes	*Scirpus spp.*
Sedges	*Carex spp.*
Spikerushes	*Eleocharis spp.*
Wild millet	*Echinochloa muricata*
Cutgrass	*Leersia spp.*

PFO1F WETLANDS (Semipermanently Flooded)

Overstory

Overcup oak*	*Quercus lyrata*
Swamp white oak*	*Quercus bicolor*
Water tupelo	*Nyssa aquatica*
Water hickory	*Carya aquatica*
Bald cypress	*Taxodium distichum*

Understory

Swamp privet	*Forestiera acuminata*
Buttonbush	*Cephalanthus occidentalis*
Swamp-haw	*Viburnum nudum*
Winterberry	*Ilex verticillata*
Common alder	*Alnus serrulata*
Swamp rose	*Rosa palustris*

Herbaceous

Arrowhead	*Sagittaria spp.*
Lizard's tail	*Saururus cernuus*
Water-Plantain	*Alisma subcordatum*
Sweet flag	*Acorus calamus*
Spatterdock	*Nuphar luteum*
Bulrushes	*Scirpus spp.*
Sedges	*Carex spp.*
Cutgrass	*Leersia spp.*

The following species are recommended for establishing groundcover on wetland soils. The use of Kentucky 31 fescue is prohibited.

Groundcover	Scientific name
Rice cutgrass	*Leersia oryzoides*
Managrass	*Glyceria striata*
Spangle grass	*Chasmanthium latifolium*
Redtop	*Agrostis alba*
Barnyard grass	*Echinochloa crus-galli*
Alsike clover	*Trifolium hybridum*
Switchgrass	*Panicum virgatum*
Annual rye	*Secale cereale*
Wild rye	*Elymus virginicus*
Deertongue grass	*Panicum clandestinum*
Panic grass	*Panicum microcarpon*